Building Protection ToolKit (BPTK)

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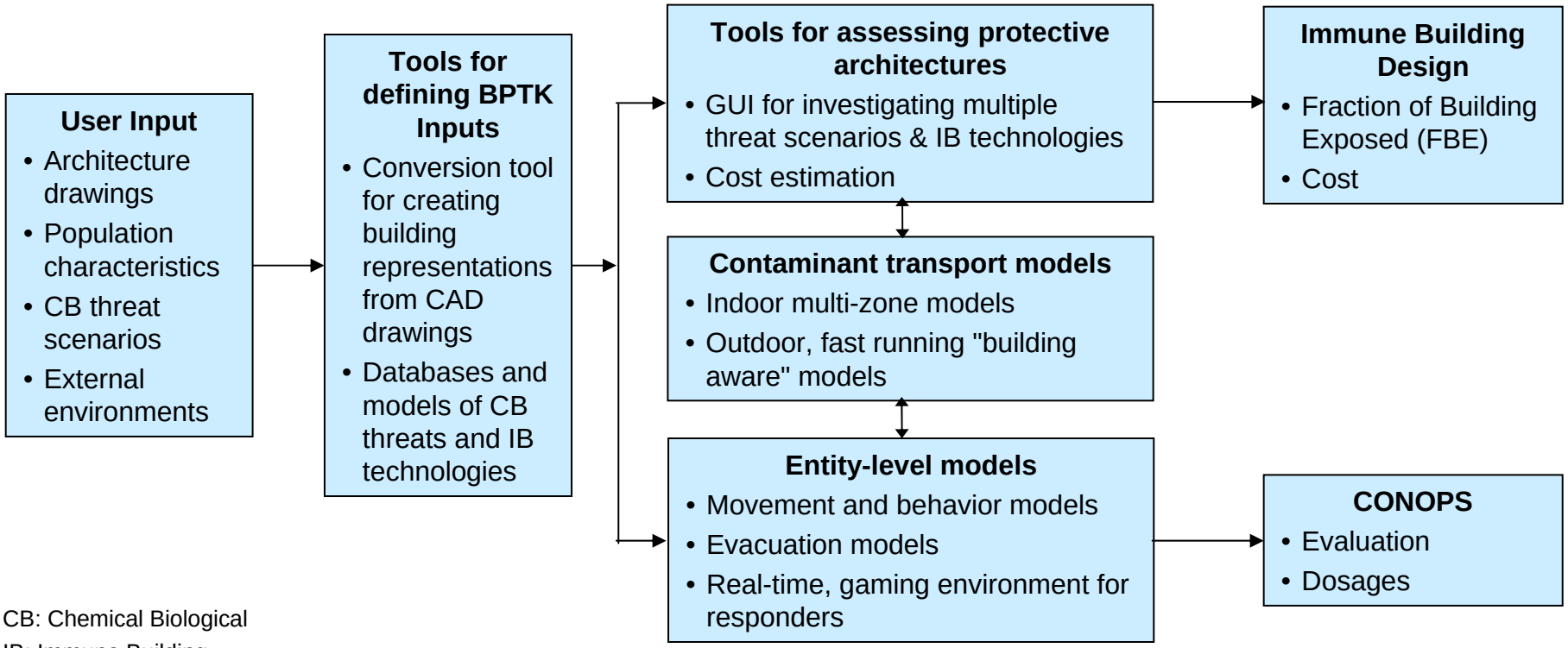
A collection of software tools for designing:

- An Immune Building
- The responses to a Chemical-Biological (CB) incident (e.g., CONOPS for first responders)



CB: Chemical Biological
IB: Immune Building
CAD: Computer Aided Design
GUI: Graphical User Interface
CONOPS: Concept of Operations

Topics

- Relation to the Immune Building Program
- Building Protection Toolkit
- MESO w/RUSTIC
  - External Transport Modeling
- Immune Building ToolKit
  - Automated Multi-Zonal Model Creation
- Analytical Conflict and Tactical Simulation
  - External Environment and Human Interactions

Immune Building Program

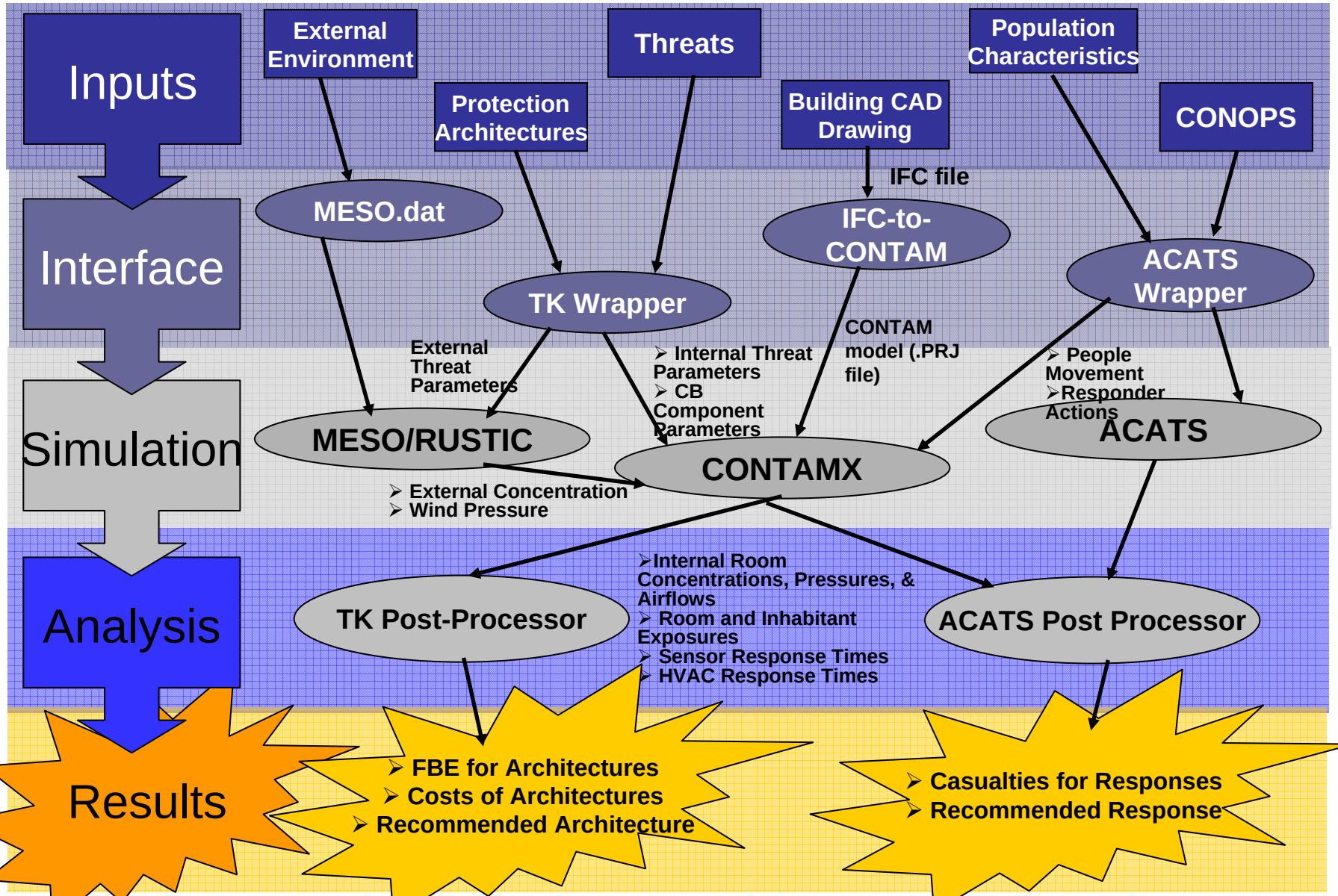
- Threat:
  - Focus on protecting military buildings from:
    - » Attack by chemical or bio warfare agents.
    - » External or internal release.
- Goal:
  - Make buildings far less attractive targets.
- Approach:
  - Reduce effectiveness of attack via dynamic response of HVAC (and other) infrastructure.
- Objectives:
  - Protect human occupants
    - » Stop/neutralize agent before it reaches humans
  - Restore building to function quickly
    - » Decontaminate effectively.
  - Preserve forensic evidence.

HVAC: Heating, Ventilating, and Air-Conditioning

Building Protection ToolKit (BPTK) Objectives

- Automate Development of Building Database
  - Internal and external structure
  - Internal HVAC related infrastructure
- Provide CBR Internal/External Threat Representation
  - Libraries of threat weapons and agents
  - Models external/internal CBR transport in a complex urban environment
  - Concentration, deposition, and dosage of contaminant materials
- Analyze Protection Capabilities
  - Provides libraries of IB components
  - Evaluates and optimizes protection architectures
  - Supports cost-benefit studies and IB design principles
- Simulate people, protection, CONOPS and tactical response
  - Area security, personnel exposure/evacuation, first responder actions, etc.
- Report Results
  - Protection system components, FBE, casualties, cost

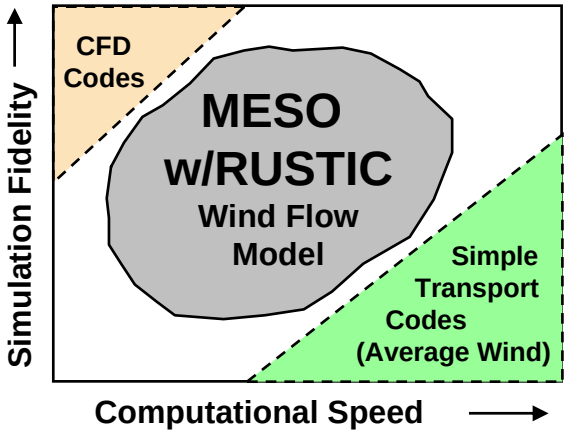
Building Protection ToolKit (BPTK) Modeling and Simulation Flow Chart

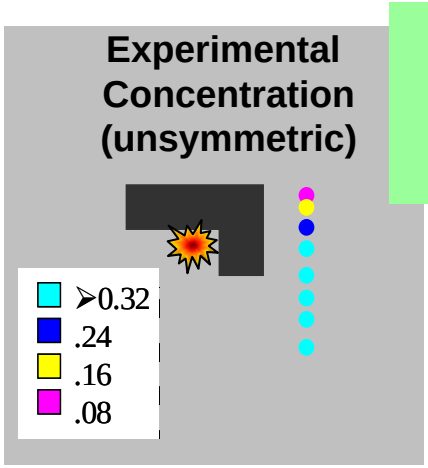


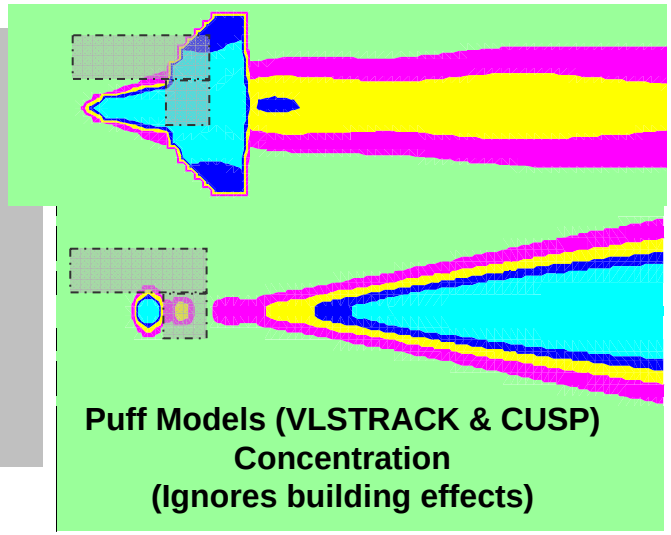
MESO / RUSTIC
External Urban Transport Modeling

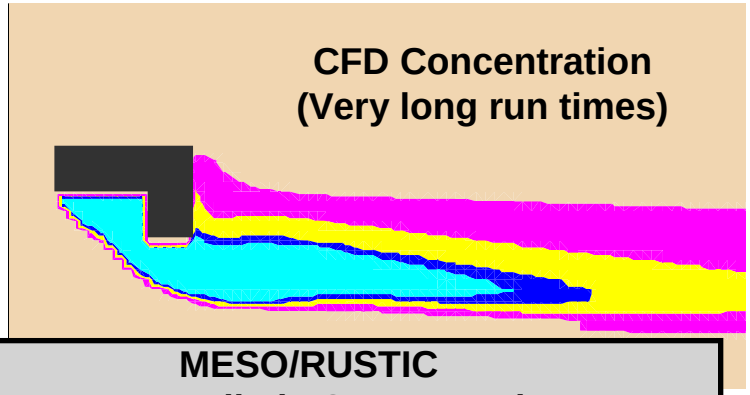
Objective: A fast-running, accurate, chemical, biological, and *radiological* urban transport capability

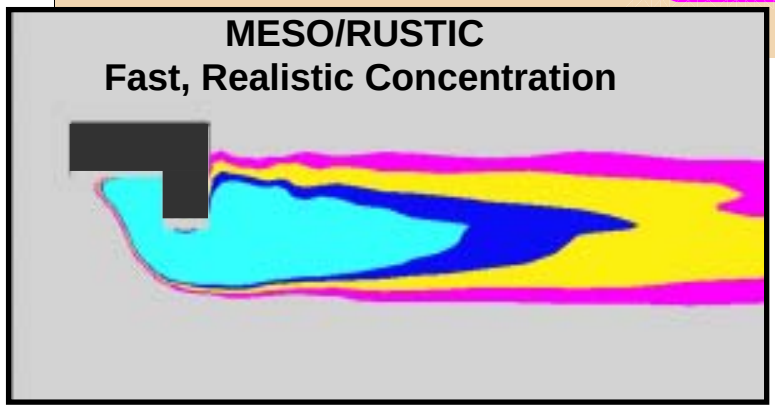
- Urban wind flow model that converges quickly (**RUSTIC**)
- Random-walk particle atmospheric transport model (**MESO**)
- k-ω turbulence model modified for flow around buildings
- Handles ground turbulence and meteorology (atmospheric stability)
- Slower than simple mass-consistent flow codes, but more defensible and accurate for urban transport
- Decreasing run times towards goal of less than 30 minutes for 1.4 x1.0 km city grid with 5 m resolution



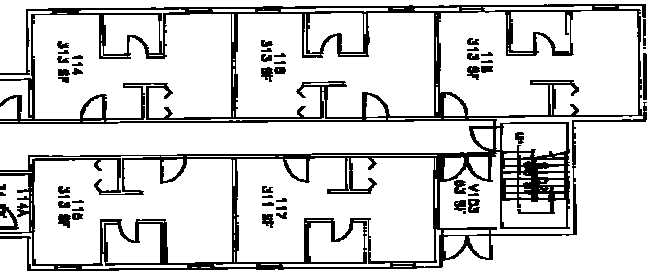


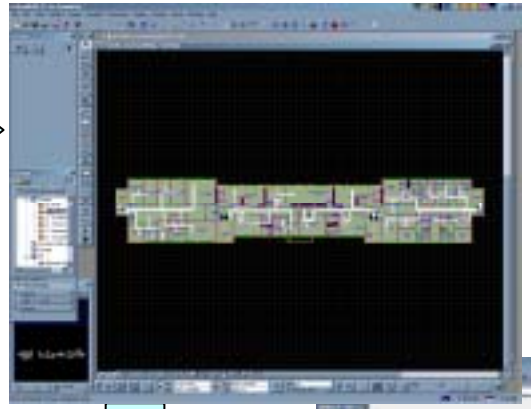


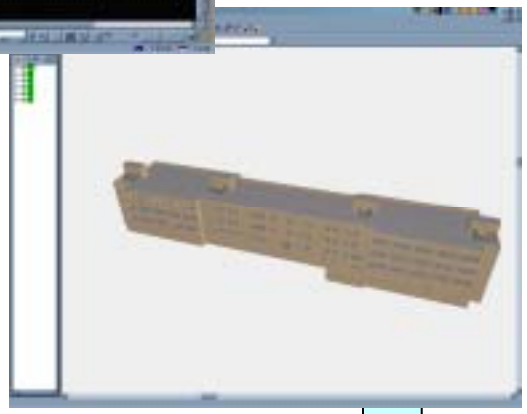


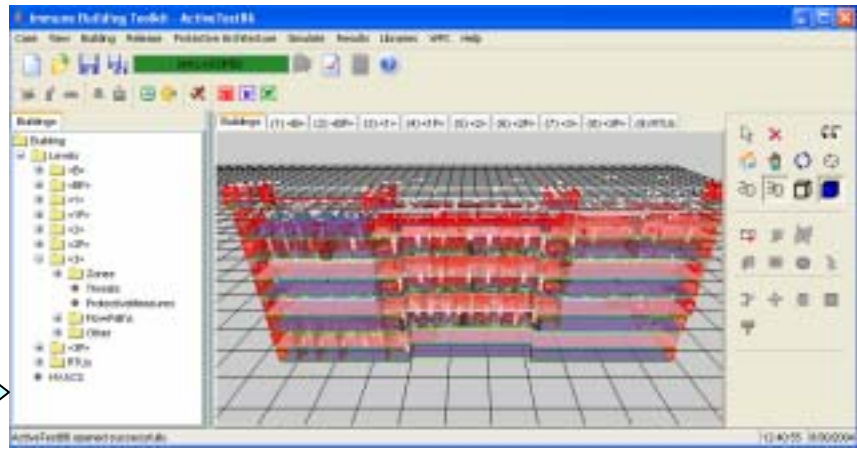


Immune Building ToolKit (IBTK)
Automated Multi-Zonal Model Creation





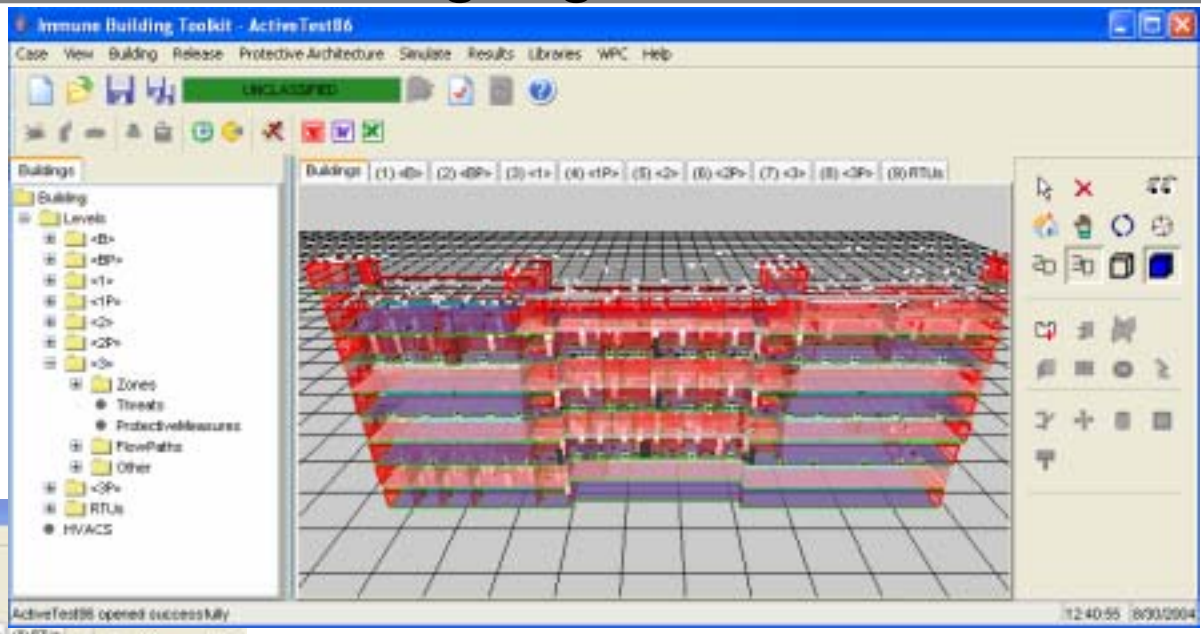


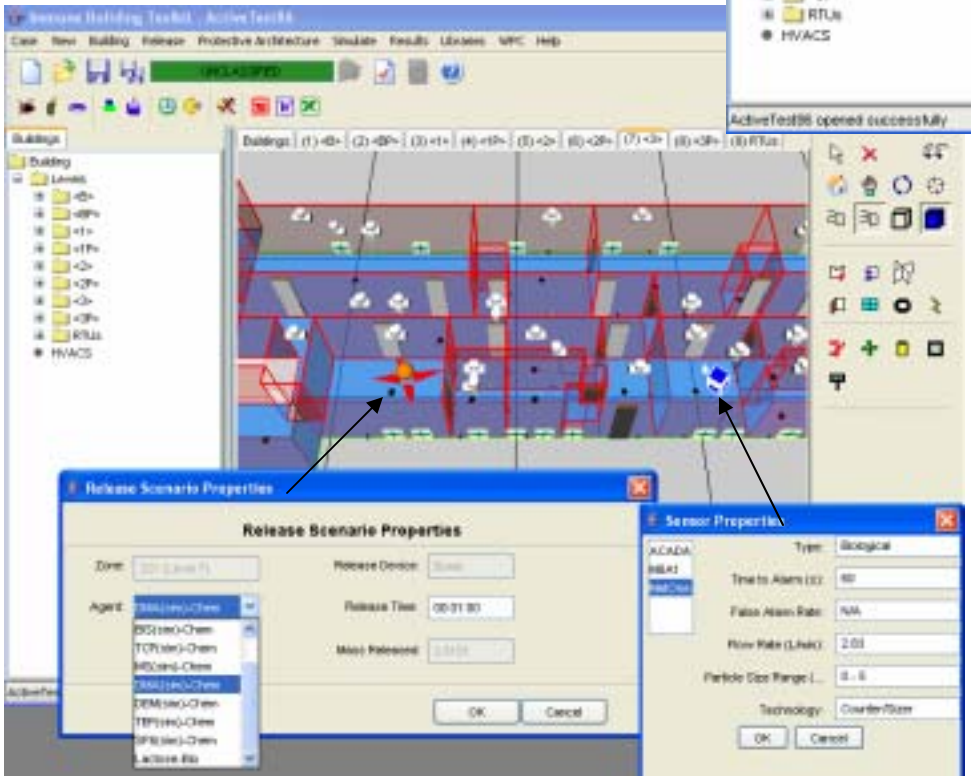


- Automated generation of multi-zonal model from Industry Foundation Class (IFC) File
  - Process for generation of IFC file from:
    - Blueprints
    - Microstation file
    - AutoCAD file
    - ArchiCAD file

Immune Building ToolKit (IBTK) Model Creation Highlights

- 3D Visualization and Element Manipulation
  - Real World Objects (doors, windows, ducts) with properties dialogs
  - Standard “tree” structure for easy search and location of objects
  - Simplified “drag and drop” interface for defining new building components
  - Cut, copy, and paste features

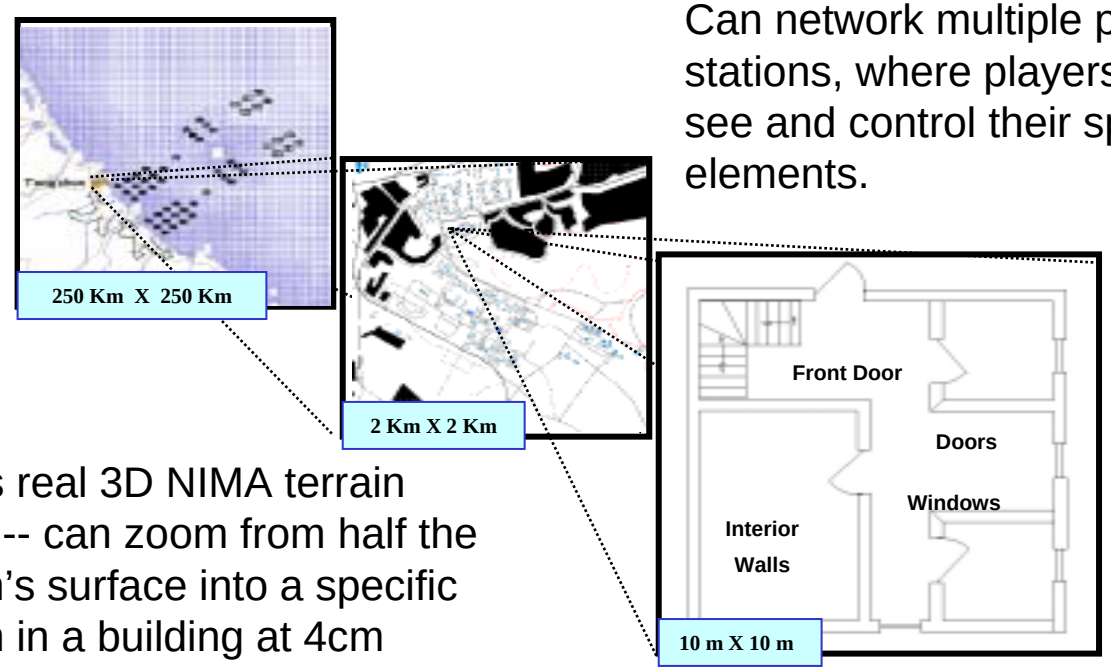




- Predefined libraries of Chemical and Biological Agents, Filters, and Sensors
- Simplified interface with default data and connection to libraries for:
  - HVAC Systems and Components
  - Protective Measures (Sensors / Filters)
  - Threats
- Integrates with external models via Weather-Pressure-Contaminant (WPC) File

Analytical Conflict and Tactical Simulation Environment and Human Interactions

- Provides analysis of CONOPS and training of responders to a CBR event in an urban area.
- Derived from the Joint Conflict and Tactical Simulation (JCATS)
  - Real-time, man-in-the-loop, force-on-force, multi-host, entity-based, client/server model tactical simulation



Can network multiple player stations, where players only see and control their specific elements.

Uses real 3D NIMA terrain data -- can zoom from half the earth's surface into a specific room in a building at 4cm accuracy

Entity based, so can build multi-sided forces to match any scenario, equipped with actual equipment, or proposed (non-existent) equipment.

Entity interactions are based on actual physics models and actual field data.

Analytical Conflict and Tactical Simulation Analysis Capabilities

- Entity movements & interactions in indoor and outdoor environments
- Fidelity at the single entity level
- External urban detail and building interiors
- Representation of essential human-response behaviors group)
  - Human response to contaminants
  - Communication, crowd control
  - Population movement, e.g.evacuation
- Emergency response coordination
- Medical triage / treatments
  - Dose response & medical load
- Sensor networks
- Decontamination
- Exposure statistics